

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (previously presented): A process for making an N-(phosphonomethyl)glycine product, the process comprising:

introducing an aqueous feed stream comprising an N-(phosphonomethyl)iminodiacetic acid substrate into an oxidation reactor system;

oxidizing N-(phosphonomethyl)iminodiacetic acid substrate in the oxidation reactor system in the presence of an oxidation catalyst to produce a reaction product solution comprising N-(phosphonomethyl)glycine product;

dividing the reaction product solution into plural fractions comprising a primary fraction and a secondary fraction;

cooling the primary fraction as water is evaporated from the primary fraction under substantially adiabatic conditions by reducing the pressure to precipitate N-(phosphonomethyl)glycine product crystals from the primary fraction to produce a primary product slurry comprising precipitated N-(phosphonomethyl)glycine product crystals and a primary mother liquor; and

precipitating N-(phosphonomethyl)glycine product crystals from an aqueous secondary crystallization feed mixture comprising N-(phosphonomethyl)glycine product contained in said secondary fraction to produce a secondary product slurry comprising precipitated N-(phosphonomethyl)glycine product crystals and a secondary mother liquor.

Claim 2 (previously presented): The process as set forth in claim 1 wherein water is evaporated from the aqueous secondary crystallization feed mixture to precipitate N-(phosphonomethyl)glycine product crystals from the aqueous secondary crystallization feed mixture.

Claims 3-4 (canceled)

Claim 5 (currently amended): The process as set forth in claim 1 wherein the evaporation cools the primary fraction to a temperature of from about 45°C to about ~~80°C~~ 80°C.

Claim 6 (previously presented): The process as set forth in claim 1 wherein from about 5% to about 30% by weight of the primary fraction is evaporated.

Claim 7 (previously presented): The process as set forth in claim 1 further comprising decanting primary mother liquor from the precipitated N-(phosphonomethyl)glycine product crystals in the primary product slurry.

Claim 8 (original): The process as set forth in claim 7 further comprising recycling primary mother liquor decanted from the precipitated N-(phosphonomethyl)glycine product crystals in the primary product slurry to the oxidation reactor system for use as a source of process water.

Claim 9 (original): The process as set forth in claim 8 wherein substantially all the primary mother liquor decanted from the precipitated N-(phosphonomethyl)glycine product crystals in the primary product slurry is recycled to the oxidation reactor system.

---

Claim 10 (currently amended): The process as set forth in claim ~~[[1]]~~ 8 wherein the oxidation catalyst comprises a heterogenous catalyst comprising a noble metal deposited on a carbon support.

Claim 11 (currently amended): The process as set forth in claim ~~[[1]]~~ 10 wherein the N-(phosphonomethyl)iminodiacetic acid substrate is oxidized in a liquid reaction medium in contact with the oxidation catalyst and the chloride ion concentration in the liquid reaction medium is maintained at no greater than about 500 ppm by weight.

Claim 12 (original): The process as set forth in claim 11 wherein the chloride ion concentration in the liquid reaction medium is maintained at no greater than 300 ppm by weight.

Claim 13 (original): The process as set forth in claim 12 wherein the chloride ion concentration in the liquid reaction medium is maintained at no greater than 100 ppm by weight.

Claim 14 (original): The process as set forth in claim 11 wherein a source of the N-(phosphonomethyl)iminodiacetic acid substrate is used to prepare the aqueous feed stream introduced into the reactor system and the concentration of chloride ion in the N-(phosphonomethyl)iminodiacetic acid substrate source is less than about 5000 ppm by weight on a dry basis.

Claim 15 (original): The process as set forth in claim 14 wherein the concentration of chloride ion in the N-(phosphonomethyl)iminodiacetic acid substrate source is less than about 3000 ppm by weight on a dry basis.

Claim 16 (original): The process as set forth in claim 15 wherein the concentration of chloride ion in the N-(phosphonomethyl)iminodiacetic acid substrate source is less than about 2000 ppm by weight on a dry basis.

---

Claim 17 (original): The process as set forth in claim 16 wherein the concentration of chloride ion in the N-(phosphonomethyl)iminodiacetic acid substrate source is less than about 1000 ppm by weight on a dry basis.

Claim 18 (previously presented): The process as set forth in claim 1 wherein the process further comprises purging secondary mother liquor for removal of by-products and impurities from the process.

Claim 19 (original): The process as set forth in claim 18 wherein substantially all the secondary mother liquor is purged from the process.

Claim 20 (previously presented): The process as set forth in claim 1 wherein the primary fraction is from about 30% to about 85% of the reaction product solution.

Claim 21 (original): The process as set forth in claim 20 wherein the primary fraction is from about 50% to about 80% of the reaction product solution.

Claim 22 (original): The process as set forth in claim 21 wherein the primary fraction is from about 65% to about 75% of the reaction product solution.

Claim 23 (original): The process as set forth in claim 20 wherein the reactor system comprises a first and a second oxidation reaction zone in series;

the aqueous feed stream is introduced into the first oxidation reaction zone;

N-(phosphonomethyl)iminodiacetic acid substrate is continuously oxidized in the first oxidation reaction zone to produce an intermediate reaction mixture comprising N-

~~(phosphonomethyl)glycine product and unreacted~~

---

N-(phosphonomethyl)iminodiacetic acid substrate;

an intermediate aqueous feed stream is introduced into the second oxidation reaction zone, the intermediate aqueous feed stream comprising N-(phosphonomethyl)glycine product obtained in the intermediate reaction mixture and unreacted

N-(phosphonomethyl)iminodiacetic acid substrate;

N-(phosphonomethyl)iminodiacetic acid substrate is continuously oxidized in the second oxidation reaction zone to produce the reaction product solution comprising N-(phosphonomethyl)glycine product; and

the reaction product solution is divided into plural fractions comprising the primary and secondary fractions.

Claim 24 (original): The process as set forth in claim 23 wherein the oxidation catalyst is in contact with a liquid reaction medium in each of the oxidation reaction zones.

Claim 25 (original): The process as set forth in claim 24 wherein the oxidation catalyst comprises a heterogenous particulate catalyst.

Claim 26 (original): The process as set forth in claim 25 wherein the heterogeneous particulate catalyst comprises a noble metal deposited on a particulate carbon support.

Claim 27 (previously presented): The process of claim 1 wherein evaporative cooling of said primary fraction comprises:

introducing an aqueous evaporation feed mixture into an evaporation zone, said aqueous feed mixture comprising said primary fraction;

evaporating water from said aqueous evaporation feed mixture in said evaporation zone in the presence of solid particulate N-(phosphonomethyl)glycine product, thereby producing a vapor phase comprising water vapor, precipitating N-(phosphonomethyl)glycine product from the aqueous liquid phase, and producing an

---

evaporation product comprising N-(phosphonomethyl)glycine product solids and a primary mother liquor that is substantially saturated or supersaturated in N-(phosphonomethyl)glycine product; and

maintaining a ratio of particulate N-(phosphonomethyl)glycine product solids to primary mother liquor in said evaporation zone which exceeds the ratio of N-(phosphonomethyl)glycine product solids incrementally produced by the effects of evaporation to mother liquor incrementally produced thereby.

Claim 28 (original): The process as set forth in claim 27 wherein said evaporation product is divided to provide an N-(phosphonomethyl)glycine product solids fraction that is relatively depleted in mother liquor and a primary mother liquor fraction that is relatively depleted in N-(phosphonomethyl)glycine product solids.

Claim 29 (original): The process as set forth in claim 28 wherein maintaining said ratio of particulate N-(phosphonomethyl)glycine product solids to mother liquor in said evaporation zone comprises returning solids obtained in said solids fraction to said evaporation zone or retaining solids obtained in said solid fraction within said zone.

Claim 30 (currently amended): The process as set forth in claim 29 comprising:

introducing ~~[[an]]~~ the aqueous evaporation feed mixture comprising said primary fraction into a vapor/liquid separation zone of said evaporation zone wherein the pressure is below the vapor pressure of said mixture, thereby allowing water to flash from the evaporation feed mixture, producing ~~[[a]]~~ said vapor phase comprising water vapor, and precipitating N-(phosphonomethyl)glycine product from the aqueous liquid phase to produce a first slurry stream comprising particulate N-(phosphonomethyl)glycine product in a saturated or supersaturated mother liquor;

---

separating said vapor phase from said first slurry stream;  
introducing said first slurry stream into a retention zone in which a supernatant liquid comprising a fraction of said mother liquor is separated from a second slurry stream comprising precipitated N-(phosphonomethyl)glycine product and mother liquor, said retention zone having an inlet for said first slurry, a decantation liquid exit for said supernatant liquid spaced above said inlet, and an exit for said second slurry spaced above said inlet but below said decantation liquid exit;  
and

maintaining the relative rates at which said first slurry is introduced into said retention zone, said second slurry is drawn off through said second slurry exit and said supernatant liquid is drawn off through said decantation liquid exit such that the upward flow velocity in a lower region of said retention zone below said second slurry exit is sufficient to maintain precipitated N-(phosphonomethyl)glycine product in suspension in the liquid phase while the upward flow velocity in an upper region of said retention zone above said second slurry exit is below the sedimentation velocity of at least 80% by weight of the N-(phosphonomethyl)glycine product particles in said lower region.

Claim 31 (original): The process as set forth in claim 30 wherein at least a portion of said second slurry stream is recirculated to said vapor/liquid separation zone.

Claim 32 (currently amended): The process as set forth in claim 31 wherein at least a portion of said second slurry stream and said primary fraction together comprise the aqueous evaporation feed mixture introduced into said vapor/liquid separation zone.

Claim 33 (original): The process as set forth in claim 32 wherein a third slurry stream is removed from said lower region of said zone.

---

Claim 34 (original): The process as set forth in claim 33 wherein the relative rates of the flow of said primary fraction to said vapor/liquid separation zone, recirculation of all or part of said second slurry stream to said vapor/liquid separation zone, withdrawal of said supernatant liquid from said decantation liquid exit, withdrawal of said third slurry stream from said lower region of said retention zone, and return to said evaporation zone of any liquid or solids bearing streams from any solids/liquid separations to which said third slurry may be subjected, are sufficient to establish a ratio of N-

(phosphonomethyl)glycine product solids to mother liquor in said lower region of said zone that is higher than the ratio of precipitated solid N-(phosphonomethyl)glycine product incrementally produced by the effects of evaporation of said primary fraction to mother liquor incrementally produced thereby.

Claim 35 (original): The process as set forth in claim 34 wherein the relative flow rates of said streams are controlled so that the N-(phosphonomethyl)glycine product solids concentration in said lower region of said zone is at least about twice the concentration of N-(phosphonomethyl)glycine product solids in the mixture of such solids and mother liquor that is or would be produced by flashing of said primary fraction in said vapor/liquid zone in the absence of said recirculated second slurry stream.

Claim 36 (currently amended): The process as set forth in claim 35 wherein solids are removed from said third slurry to produce a recycle liquid fraction which is recirculated to said vapor/liquid separation zone, whereby said aqueous evaporation feed mixture further comprises said recycle liquid fraction.

Claim 37 (original): The process as set forth in claim 36 wherein both said primary fraction and said recycle liquid fraction are mixed with said second slurry stream prior to introduction into said vapor/liquid separation zone.

---

Claim 38 (currently amended): The process as set forth in claim 23 wherein said secondary fraction is introduced into a secondary reactor system comprising a tertiary oxidation reaction zone, unreacted N-(phosphonomethyl)iminodiacetic acid substrate contained in said secondary fraction being converted to N-(phosphonomethyl)glycine product in said tertiary oxidation reaction zone to produce a tertiary oxidation reaction mixture, said secondary crystallization feed mixture comprising N-



(phosphonomethyl)glycine product contained in said tertiary oxidation reaction mixture.

Claim 39 (original): The process as set forth in claim 37 wherein the relative flow rates of all of said streams, including said recycle liquid fraction, are controlled so that the solids content of the slurry in said lower region of said zone is at least about 12% by weight.

Claim 40 (currently amended): The process as set forth in claim ~~[[39]]~~ 20 further comprising decanting primary mother liquor from the precipitated N-(phosphonomethyl)glycine product crystals in the primary product slurry.

Claim 41 (currently amended): The process as set forth in claim ~~[[39]]~~ 40 further comprising recycling primary mother liquor to said oxidation reactor system for use as a source of water.

Claim 42 (currently amended): The process as set forth in claim ~~[[39]]~~ 20 further comprising purging secondary mother liquor for removal of by-products and impurities from the process.

Claim 43 (currently amended): The process as set forth in claim ~~[[39]]~~ 20 wherein said oxidation reactor system comprises a ~~series of at least two continuous oxidation reaction zones, the~~  
process further comprising:

separating the oxidation catalyst from reaction product solution; and

continuously recycling the separated oxidation catalyst to at least one of the oxidation reaction zones.

Claim 44 (currently amended): A process for making an N-(phosphonomethyl)glycine product, the process comprising:  
introducing an aqueous feed stream comprising an N-(phosphonomethyl)iminodiacetic acid substrate into an oxidation reactor system;

oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the oxidation reactor system in the presence of an oxidation catalyst to produce a reaction product solution containing N-(phosphonomethyl)glycine product;

precipitating N-(phosphonomethyl)glycine product crystals from the reaction product solution to produce a primary product slurry comprising precipitated N-(phosphonomethyl)glycine product crystals and a primary mother liquor;

separating precipitated N-(phosphonomethyl)glycine product from said primary mother liquor; and

subjecting the primary mother liquor to heat-driven evaporative crystallization to thereby evaporate evaporating water from the primary mother liquor, ~~thereby precipitating~~ precipitate additional N-(phosphonomethyl)glycine product crystals and producing produce a secondary mother liquor.

Claim 45 (original): The process as set forth in claim 44 wherein the reaction product solution is cooled to precipitate N-(phosphonomethyl)glycine product crystals from the reaction product solution.

Claim 46 (original): The process as set forth in claim 45 wherein the reaction product solution is cooled as water is evaporated from the reaction product solution by reducing the pressure.

---

Claim 47 (original): The process as set forth in claim 46 wherein water is evaporated from the reaction product solution under substantially adiabatic conditions.

Claim 48 (original): The process as set forth in claim 47 wherein the evaporation cools the reaction product solution to a temperature of from about 45°C to about 80°C.

Claim 49 (original): The process as set forth in claim 47 wherein from about 5% to about 30% by weight of the reaction product solution is evaporated.

Claim 50 (original): The process as set forth in claim 47 wherein the process further comprises purging secondary mother liquor for removal of by-products and impurities from the process.

Claim 51 (original): The process as set forth in claim 50 wherein substantially all the secondary mother liquor is purged from the process.

Claim 52 (original): A process for making an N-(phosphonomethyl)glycine product, the process comprising:

- introducing an aqueous feed stream comprising an N-(phosphonomethyl)iminodiacetic acid substrate into a primary oxidation reactor system comprising one or more oxidation reaction zones;
- oxidizing N-(phosphonomethyl)iminodiacetic acid substrate in the primary oxidation reactor system to produce a reaction product solution comprising N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate;
- dividing the reaction product solution into plural fractions ~~comprising a primary fraction and a secondary oxidation reactor feed fraction;~~
- precipitating N-(phosphonomethyl)glycine product crystals from the primary fraction to produce a primary product slurry comprising precipitated N-(phosphonomethyl)glycine product crystals and a primary mother liquor;
- introducing the secondary oxidation reactor feed fraction into a secondary oxidation reactor system comprising one or more oxidation reaction zones;
- oxidizing N-(phosphonomethyl)iminodiacetic acid substrate in the secondary oxidation reactor system to produce a secondary

oxidation reactor effluent comprising N-(phosphonomethyl)glycine product; and

precipitating N-(phosphonomethyl)glycine product crystals from the secondary oxidation reactor effluent to produce a secondary product slurry comprising precipitated N-(phosphonomethyl)glycine product crystals and a secondary mother liquor.

Claim 53 (original): The process as set forth in claim 52 wherein the primary fraction is cooled to precipitate N-(phosphonomethyl)glycine product crystals from the primary fraction and water is evaporated from the secondary oxidation reactor effluent to precipitate N-(phosphonomethyl)glycine product crystals from the secondary oxidation reactor effluent.

Claim 54 (original): The process as set forth in claim 53 wherein the primary fraction is cooled as water is evaporated from the primary fraction by reducing the pressure.

Claim 55 (original): The process as set forth in claim 54 wherein the water is evaporated from the primary fraction under substantially adiabatic conditions.

Claim 56 (original): The process as set forth in claim 52  
~~wherein the primary reactor system comprises multiple oxidation~~  
reaction zones in series.

Claim 57 (original): The process as set forth in claim 56 wherein the reaction product solution is divided after the last oxidation reaction zone in the series.

Claim 58 (original): The process as set forth in claim 56 wherein the reaction product solution is divided before the last oxidation reaction zone in the series and the primary fraction passes through at least one further oxidation reaction zone in the primary reactor system before precipitating N-

(phosphonomethyl)glycine product crystals from the primary fraction.

Claim 59 (original): The process as set forth in claim 52 wherein the primary reactor system comprises a single oxidation reaction zone.

Claim 60 (original): The process as set forth in claim 52 wherein the secondary oxidation reactor system comprises a stirred tank reactor.

Claim 61 (original): The process as set forth in claim 52 wherein the secondary oxidation reactor system comprises a fixed bed reactor.

Claim 62 (original): The process as set forth in claim 61 wherein the fixed bed reactor is operated with cocurrent gas and liquid flows through the oxidation reaction zone.

Claim 63 (original): The process as set forth in claim 61 wherein the fixed bed reactor is operated adiabatically.

Claim 64 (currently amended): The process as set forth in claim 52 wherein the secondary oxidation reactor feed fraction is cooled prior to introduction into the secondary oxidation reactor system.

---

Claims 65-95 (canceled)

Claim 96 (original): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate, the process comprising:

introducing the N-(phosphonomethyl)iminodiacetic acid substrate into a liquid reaction medium within an oxidation reaction zone, the liquid reaction medium comprising the N-

(phosphonomethyl)glycine product and having a particulate heterogeneous catalyst for the oxidation reaction suspended therein;

introducing an oxidizing agent into the oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the liquid reaction medium within the oxidation reaction zone to form the N-(phosphonomethyl)glycine product;

continuously withdrawing a reaction mixture effluent from said oxidation reaction zone, the reaction mixture effluent comprising the N-(phosphonomethyl)glycine product;

continuously separating the particulate catalyst from the reaction mixture effluent to form a catalyst recycle stream comprising the separated catalyst; and

introducing at least a portion of the particulate catalyst contained in the catalyst recycle stream into said oxidation reaction zone.

Claim 97 (original): The process as set forth in claim 96 wherein particulate catalyst contained in the catalyst recycle stream passes through at least one other oxidation reaction zone before being introduced into said oxidation reaction zone.

Claim 98 (original): The process as set forth in claim 96  
~~wherein particulate catalyst contained in the catalyst recycle~~  
stream is introduced directly into said oxidation reaction zone.

Claim 99 (original): The process as set forth in claim 96 wherein the particulate catalyst is separated from the reaction mixture effluent in a catalyst filter to form the catalyst recycle stream and a filtrate substantially free of the particulate catalyst and comprising N-(phosphonomethyl)glycine product.

Claim 100 (original): The process as set forth in claim 99 wherein the catalyst filter is adapted for continuous separation of the particulate catalyst from the reaction mixture effluent.

Claims 101-217 (canceled)

Claim 218 (currently amended): A process for the preparation of an N-(phosphonomethyl)glycine product comprising:

introducing an aqueous feed mixture comprising an N-(phosphonomethyl)iminodiacetic acid substrate into a liquid reaction medium;

**catalytically** oxidizing N-(phosphonomethyl)iminodiacetic acid substrate in said aqueous liquid reaction medium in the presence of a heterogenous oxidation catalyst comprising a noble metal on carbon thereby producing a reaction mixture comprising N-(phosphonomethyl)glycine product;

cooling a primary crystallization feed mixture comprising N-(phosphonomethyl)glycine product produced in said reaction mixture, thereby precipitating N-(phosphonomethyl)glycine product and producing a primary mother liquor comprising N-(phosphonomethyl)glycine product;

separating precipitated N-(phosphonomethyl)glycine product from said primary mother liquor; and

recycling primary mother liquor and introducing it into said liquid reaction medium wherein N-(phosphonomethyl)iminodiacetic acid substrate is oxidized to N-(phosphonomethyl)glycine product.

---

Claim 219 (original): The process as set forth in claim 218 wherein said reaction mixture is divided into a primary fraction and a secondary fraction, said primary crystallization feed mixture comprising N-(phosphonomethyl)glycine product obtained in said primary fraction.

Claim 220 (original): The process as set forth in claim 219 wherein N-(phosphonomethyl)glycine product is crystallized from a secondary crystallizer feed mixture comprising N-

(phosphonomethyl)glycine product obtained in said secondary fraction, thereby producing a secondary mother liquor comprising N-(phosphonomethyl)glycine product and by-products of said oxidation reaction.

Claim 221 (original): The process as set forth in claim 220 wherein an aqueous secondary reactor feed mixture, comprising N-(phosphonomethyl)glycine product obtained in said secondary fraction and unreacted -(phosphonomethyl)iminodiacetic acid substrate contained therein, is introduced into a secondary oxidation zone wherein unreacted -(phosphonomethyl)iminodiacetic acid substrate is oxidized to produce a secondary oxidation reaction mixture containing additional N-(phosphonomethyl)glycine product, said secondary crystallizer feed mixture comprising said secondary oxidation reaction mixture.

Claim 222 (original): The process as set forth in claim 221 wherein said secondary oxidation zone comprises a fixed bed containing a catalyst for the oxidation.

Claim 223 (original): The process as set forth in claim 220 wherein crystallization of N-(phosphonomethyl)glycine product from said primary crystallization feed mixture comprises evaporative cooling of said primary feed mixture.

---

Claim 224 (original): The process as set forth in claim 223 wherein water constituting between about 5% and about 30% by weight of said primary crystallization feed mixture is removed in evaporative cooling thereof.

Claim 225 (original): The process as set forth in claim 223 wherein said evaporative cooling is conducted substantially adiabatically.

Claim 226 (original): The process as set forth in claim 224 wherein crystallization of said N-(phosphonomethyl)glycine



product from said secondary crystallization feed mixture comprises heat-driven evaporative crystallization.

Claim 227 (previously presented): The process as set forth in claim 218 wherein N-(phosphonomethyl)iminodiacetic acid substrate is oxidized in said aqueous liquid reaction medium in a primary oxidation reaction zone, thereby producing a primary oxidation product, the process further comprising:

dividing said primary oxidation product into a finishing reaction feed mixture and a primary crystallization fraction, said primary crystallization feed mixture comprising said primary crystallization fraction;

introducing said finishing reaction feed mixture into a finishing reaction zone; and

catalytically oxidizing residual N-(phosphonomethyl)iminodiacetic acid substrate contained in said finishing reaction feed mixture to N-(phosphonomethyl)glycine product to produce a finished reaction mixture.

Claim 228 (original): The process as set forth in claim 227 wherein said primary oxidation product contains between about 0.5% and about 2% by weight unreacted -(phosphonomethyl)iminodiacetic acid.

---

Claim 229 (original): ~~The process as set forth in claim 228~~ wherein a secondary crystallizer feed mixture comprising N-(phosphonomethyl)glycine product obtained in said finished reaction mixture is subjected to heat-driven evaporative crystallization, thereby precipitating N-(phosphonomethyl)glycine product and producing a secondary mother liquor comprising N-(phosphonomethyl)glycine product and by-products of the oxidation of N-(phosphonomethyl)iminodiacetic acid substrate.

Claim 230 (currently amended): The process as set forth in claim 218 wherein N-(phosphonomethyl)iminodiacetic acid substrate is continuously oxidized in the presence of said heterogenous

oxidation catalyst, said heterogenous oxidation catalyst comprising a noble metal on a particulate carbon support catalyst.

Claim 231 (currently amended): A process for the preparation of an N-(phosphonomethyl)glycine product comprising:

introducing an aqueous feed mixture comprising an N-(phosphonomethyl)iminodiacetic acid substrate into a catalytic reactor system comprising one or more catalytic reaction zones;

catalytically oxidizing N-(phosphonomethyl)iminodiacetic acid substrate to N-(phosphonomethyl)glycine product in said catalytic reactor system to produce a product mixture;

dividing said product mixture into a primary fraction and a secondary fraction;

crystallizing N-(phosphonomethyl)glycine product from said primary fraction to produce a solid N-(phosphonomethyl)glycine product fraction and a primary mother liquor;

recycling primary mother liquor for use as a source of water in the preparation of said feed mixture; and

crystallizing N-(phosphonomethyl)glycine product from said secondary fraction to produce additional solid N-(phosphonomethyl)glycine product and a secondary mother liquor.

Claim 232 (original): The process as set forth in claim 231

~~wherein substantially all of said primary mother liquor is~~

recycled as a source of water in the preparation of said feed mixture.

Claim 233 (original): The process as set forth in claim 231 wherein N-(phosphonomethyl)glycine is crystallized from said primary fraction by evaporative crystallization.

Claim 234 (canceled)

Claim 235 (original): The process as set forth in claim ~~[[234]]~~ 231 wherein N-(phosphonomethyl)glycine is crystallized from said secondary fraction by evaporative crystallization.

Claim 236 (original): The process as set forth in claim 235 wherein N-(phosphonomethyl)glycine is crystallized from said primary fraction by substantially adiabatic evaporative crystallization.

Claim 237 (original): The process as set forth in claim 235 wherein said feed mixture is continuously introduced into said reactor system, a reaction zone within said system being substantially back-mixed with respect to the liquid phase therein, the exothermic heat of reaction serving to heat the contents of the feed mixture to the reaction temperature prevailing in said back-mixed reaction zone.

Claim 238 (original): The process as set forth in claim 237 wherein the catalyst for said reaction comprises a noble metal and is effective to oxidize C<sub>1</sub> by-products selected from the group consisting of formaldehyde and formic acid, the oxidation of said C<sub>1</sub> by-products further contributing to heating the contents of said aqueous feed mixture.

---

Claim 239 (currently amended): ~~The process as set forth in claim~~ 231 wherein N-(phosphonomethyl)iminodiacetic acid is oxidized in the presence of a heterogeneous catalyst comprising a noble metal, a fraction of noble metal is leached from said catalyst in said catalytic oxidation reactor system, leached noble metal contained in said primary fraction being returned to said catalytic reactor system in said primary mother liquor.

Claim 240 (original): The process as set forth in claim 239 wherein leached noble metal contained in said recycle primary mother liquor inhibits further leaching of noble metal from said catalyst in said catalytic reactor system.

Claim 241 (original): The process as set forth in claim 239 wherein a portion of leached noble metal contained in said recycle mother liquor is redeposited on the surface of said heterogeneous catalyst in said catalytic reactor system.

Claim 242 (original): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

introducing a liquid phase feed stream comprising an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a primary oxidation reaction zone, the primary oxidation reaction zone comprising a primary fixed bed containing an oxidation catalyst;

introducing an oxidizing agent into the primary oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate to the N-(phosphonomethyl)glycine product in the primary oxidation reaction zone, thereby producing a primary reaction mixture comprising the N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate;

withdrawing the primary reaction mixture from the primary oxidation reaction zone; and

---

~~maintaining the difference in unit weight sensible heat~~  
content between said reaction mixture and said aqueous feed stream less than the exothermic reaction heat generated in the reaction zone per unit weight of the aqueous feed stream.

Claim 243 (original): The process as set forth in claim 242 wherein maintaining the difference in unit weight sensible heat content between said reaction mixture and said aqueous feed stream less than the exothermic reaction heat generated in the reaction zone per unit weight of the aqueous feed stream comprises cooling of said fixed bed by indirect transfer of heat

to a heat transfer or process fluid flowing through a conduit within or in contact with said bed.

Claim 244 (original): The process as set forth in claim 242 wherein maintaining the difference in unit weight sensible heat content between said reaction mixture and said aqueous feed stream less than the exothermic reaction heat generated in the reaction zone per unit weight of the aqueous feed stream comprises introducing into said bed a recirculation fraction comprising N-(phosphonomethyl)glycine product produced in the reaction wherein said recirculation fraction has been cooled externally of said fixed bed.

Claim 245 (original): The process as set forth in claim 244 comprising:

dividing the primary reaction mixture into a primary product fraction and a primary reactor circulation fraction;

passing the primary reaction mixture or the primary reactor recirculation fraction through a heat exchanger for removal of heat of oxidation of the N-(phosphonomethyl)iminodiacetic acid substrate; and

returning the primary reactor recirculation fraction to the primary oxidation reaction zone.

---

~~Claim 246 (original): The process as set forth in claim 245~~

~~wherein said primary reaction mixture is passed through said heat exchanger before said primary reaction mixture is divided.~~

Claim 247 (original): The process as set forth in claim 245 wherein the ratio of the volumetric flow rate of the primary reactor recirculation fraction to the volumetric flow rate of the primary product fraction is at least about 0.5:1.

Claim 248 (original): The process as set forth in claim 247 wherein the ratio of the volumetric flow rate of the primary

reactor recirculation fraction to the volumetric flow rate of the primary product fraction is from about 1:1 to about 10:1.

Claim 249 (original): The process as set forth in claim 244 wherein the aqueous feed stream and the primary reactor recirculation fraction are mixed to produce a combined inlet stream, the liquid phase feed stream introduced into the oxidation reaction zone comprising said combined inlet feed stream.

Claim 250 (original): The process as set forth in claim 249 wherein the aqueous feed stream comprises a slurry of N-(phosphonomethyl)iminodiacetic acid substrate in a substantially saturated aqueous solution of N-(phosphonomethyl)iminodiacetic acid substrate, and the primary reactor recirculation fraction has a lower N-(phosphonomethyl)iminodiacetic acid substrate content than the aqueous feed stream, whereby the combined inlet stream obtained by mixing the aqueous feed stream with the primary reactor recirculation fraction is substantially free of N-(phosphonomethyl)iminodiacetic acid substrate solids under the conditions prevailing at the liquid inlet region of the primary fixed bed.

Claim 251 (original): The process as set forth in claim 250 wherein the aqueous feed stream comprises a slurry containing between about 8% and about 15% N-(phosphonomethyl)iminodiacetic acid substrate and the primary reactor recirculation fraction comprises a solution containing between about 0.5% and about 5% by weight N-(phosphonomethyl)iminodiacetic acid substrate.

Claim 252 (original): The process as set forth in claim 242 further comprising:

introducing a second reactor feed mixture comprising at least a portion of the primary product fraction into a second oxidation reaction zone, the second oxidation reaction zone comprising a second fixed bed containing an oxidation catalyst;

introducing an oxidizing agent into the second oxidation reaction zone; and

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate and a by-product C<sub>1</sub> compound in the second oxidation reaction zone to produce a second reaction product mixture containing N-(phosphonomethyl)glycine product.

Claim 253 (original): The process as set forth in claim 252 wherein at least 95% of the N-(phosphonomethyl)iminodiacetic acid substrate contained in the aqueous feed stream is oxidized in the primary and second oxidation reaction zones.

Claim 254 (original): The process as set forth in claim 253 wherein at least 98% of the N-(phosphonomethyl)iminodiacetic acid substrate contained in the aqueous feed stream is oxidized in the primary and second oxidation reaction zones.

Claim 255 (original): The process as set forth in claim 242 wherein the primary fixed bed in the primary oxidation reaction zone contains a noble metal on carbon catalyst.

Claim 256 (original): The process as set forth in claim 255 wherein the primary fixed bed in the primary oxidation reaction zone contains a carbon catalyst without a noble metal.

---

Claim 257 (original): The process as set forth in claim 256 further comprising:

introducing at least a portion of the second reaction mixture into a third oxidation reaction zone comprising a fixed bed containing an oxidation catalyst;

introducing an oxidizing agent into the third oxidation reaction zone; and

continuously oxidizing a by-product C<sub>1</sub> compound in the third oxidation reaction zone to produce a third reaction product mixture containing N-(phosphonomethyl)glycine product.

Claim 258 (original): The process as set forth in claim 257 further comprising oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the third oxidation reaction zone.

Claim 259 (original): The process as set forth in claim 257 wherein the fixed bed in the third oxidation reaction zone contains a noble metal on carbon catalyst, reaction in the third oxidation reaction zone comprising catalytic oxidation of C<sub>1</sub> compound remaining in the second reaction mixture.

Claim 260 (original): The process as set forth in claim 257 wherein the liquid phase reacting mixture passes through the third fixed bed in substantially plug flow and substantially without recirculation of said third reaction product mixture or other effluent therefrom.

Claim 261 (original): The process as set forth in claim 260 wherein the third oxidation reaction zone is operated substantially without back-mixing of the liquid phase reacting mixture.

Claim 262 (original): The process as set forth in claim 255 wherein the fixed bed in the primary oxidation reaction zone contains a noble metal on carbon catalyst, a C<sub>1</sub> compound being oxidized in the primary oxidation reaction zone.

---

Claim 263 (original): The process as set forth in claim 252 wherein the liquid phase reacting mixture passes through the second fixed bed in substantially plug flow and substantially without recirculation of said second reaction product mixture or other effluent therefrom.

Claim 264 (original): The process as set forth in claim 252 wherein the second oxidation reaction zone is operated substantially without back-mixing of the liquid phase reacting mixture.



Claim 265 (original): The process as set forth in claim 252 further comprising transferring heat of reaction generated in the second oxidation reaction zone to a cooling fluid.

Claim 266 (original): The process as set forth in claim 252 wherein the second oxidation reaction zone operates substantially adiabatically.

Claim 267 (original): The process as set forth in claim 242 wherein the oxidizing agent is an O<sub>2</sub>-containing gas and the integrated average oxygen partial pressure over the liquid phase flow path in the primary oxidation reaction zone is at least about 50 psia.

Claim 268 (original): The process as set forth in claim 267 wherein the integrated average oxygen partial pressure over the liquid phase flow path in the primary oxidation reaction zone is at least about 100 psia.

Claim 269 (original): The process as set forth in claim 267 wherein the oxygen concentration of the gas phase at the gas exit of the reactor is between about 20% and about 30% by volume.

Claim 270 (original): The process as set forth in claim 267 ~~wherein oxygen utilization in the primary oxidation reaction zone~~  
is between about 50% and about 95%.

Claim 271 (original): The process as set forth in claim 242 wherein the integrated average temperature of the liquid phase across the liquid phase flow path through the primary oxidation reaction zone is between about 80°C and about 130°C.

Claim 272 (original): The process as set forth in claim 242 wherein the integrated average temperature of the liquid phase across the liquid phase flow path through the primary oxidation reaction zone is between about 105°C and about 120°C.

Claim 273 (original): The process as set forth in claim 242 wherein the ratio of catalyst surface area to volume of liquid phase reacting mixture in the primary fixed bed is from about 100 to about 6000 m<sup>2</sup>/cm<sup>3</sup>.

Claim 274 (original): The process as set forth in claim 273 wherein the ratio of catalyst surface area to volume of liquid phase reacting mixture in the primary fixed bed is from about 200 to about 2000 m<sup>2</sup>/cm<sup>3</sup>.

Claim 275 (original): The process as set forth in claim 242 wherein the oxidizing agent is an O<sub>2</sub>-containing gas and the liquid phase and the gas phase flow co-currently through the primary fixed bed.

Claim 276 (original): The process as set forth in claim 242 wherein the oxidizing agent is an O<sub>2</sub>-containing gas and the liquid phase and the gas phase flow countercurrently through the primary fixed bed.

Claim 277 (original): The process as set forth in claim 242 wherein the catalyst activity within the primary fixed bed varies along the liquid phase flow path through the reactor, the activity of the catalyst in an upstream section of the primary fixed bed with respect to the direction of liquid phase flow 

---

being lower than the catalyst activity in a downstream section.

Claim 278 (currently amended): A process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into the first of a series of oxidation reaction zones, each of the series of oxidation reaction zones comprising an oxidation catalyst;

oxidizing the ~~[[an]]~~ N-(phosphonomethyl)iminodiacetic acid substrate in the first oxidation reaction zones to produce an intermediate oxidation reaction product;

introducing the intermediate oxidation reaction product into a second oxidation reaction zone comprising a fixed bed containing a noble metal on carbon catalyst; and

oxidizing by-product formaldehyde and/or formic acid in the second oxidation reaction zone.

Claim 279 (original): The process as set forth in claim 278 wherein the first and second oxidation reaction zones comprise continuous oxidation reaction zones, the aqueous feed stream being continuously or intermittently introduced into the first oxidation reaction zone, the intermediate oxidation product being continuously or intermittently withdrawn from the first oxidation reaction zone and continuously or intermittently introduced into the second oxidation reaction zone.

Claim 280 (original): The process as set forth in claim 279 wherein the intermediate oxidation reaction product is cooled prior to being introduced into the second oxidation reaction zone.

Claim 281 (original): The process as set forth in claim 280 ~~wherein each of the oxidation reaction zones comprises a fixed~~  

---

bed containing a catalyst for the oxidation of N-(phosphonomethyl)iminodiacetic acid substrate to N-(phosphonomethyl)glycine product, each except the last of the series producing an intermediate reaction product which is introduced into the next succeeding oxidation reaction zone in the series, and a final reaction product comprising N-(phosphonomethyl)glycine product being withdrawn from the last of the oxidation reaction zones.

Claim 282 (original): The process as set forth in claim 281 wherein the series comprises more than two oxidation reaction

zones, the intermediate reaction mixture exiting each of the first two of the oxidation reaction zones being cooled before being introduced into the next succeeding oxidation reaction zone.

Claim 283 (original): The process as set forth in claim 282 wherein the intermediate reaction mixture is cooled before being introduced into the next succeeding oxidation reaction zone.

Claim 284 (original): The process as set forth in claim 282 wherein said aqueous feed mixture contains at least about 15% by weight of a water-soluble salt of N-(phosphonomethyl)iminodiacetic acid on an acid equivalent basis and said final reaction mixture contains at least about 12% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

Claim 285 (original): The process as set forth in claim 284 wherein said aqueous feed mixture contains at least about 25% by weight of a water-soluble salt of N-(phosphonomethyl)iminodiacetic acid on an acid equivalent basis and said final oxidation reaction mixture contains at least about 20% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

---

Claim 286 (original): The process as set forth in claim 285 wherein said aqueous feed mixture contains at least about 35% by weight of a water-soluble salt of N-(phosphonomethyl)iminodiacetic acid on an acid equivalent basis and said final oxidation reaction mixture contains at least about 28% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

Claim 287 (original): The process as set forth in claim 284 wherein a final oxidation reaction is concentrated by removal of water therefrom.

Claim 288 (original): A process as set forth in claim 287 wherein said final reaction mixture is introduced into a flash evaporation zone wherein the pressure is lower than the vapor pressure of said final oxidation mixture at the temperature at which it exits the last of said series of reactors.

Claim 289 (original): The process as set forth in claim 278 wherein the first oxidation reaction zone comprises a substantially back-mixed oxidation reaction zone within a continuous stirred tank reactor.

Claim 290 (original): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into an oxidation reaction zone comprising a fixed bed containing an oxidation catalyst;

introducing an O<sub>2</sub>-containing gas into the oxidation reaction zone; and

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate to the N-(phosphonomethyl)glycine product in the oxidation reaction zone, thereby producing an oxidation reaction mixture comprising the N-(phosphonomethyl)glycine product, the ratio of the mass flow rate of the liquid phase to the mass flow rate of gas phase in the fixed bed being between about 20 and about 800.

---

Claim 291 (original): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into an oxidation

reaction zone comprising a fixed bed containing an oxidation catalyst;

introducing an O<sub>2</sub>-containing gas into the oxidation reaction zone; and

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate to N-(phosphonomethyl)glycine product in the oxidation reaction zone, thereby producing an oxidation reaction mixture comprising the N-(phosphonomethyl)glycine product, the volumetric ratio of the liquid phase holdup in the fixed bed to the total bed volume being between about 0.1 and about 0.5.

Claim 292 (original): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into an oxidation reaction zone comprising a fixed bed containing an oxidation catalyst;

introducing an O<sub>2</sub>-containing gas into the oxidation reaction zone; and

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate to the N-(phosphonomethyl)glycine product in the oxidation reaction zone, thereby producing an oxidation reaction mixture comprising the N-(phosphonomethyl)glycine product, the

---

partial pressure of oxygen at the liquid exit of the fixed bed being not greater than about 100 psia.

Claim 293 (original): The process as set forth in claim 292 wherein the partial pressure of oxygen at the liquid exit of the fixed bed is between about 10 and about 50 psia.

Claim 294 (original): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into an oxidation reaction zone comprising a fixed bed containing an oxidation catalyst;

introducing an O<sub>2</sub>-containing gas into the oxidation reaction zone; and

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate to the N-(phosphonomethyl)glycine product in the oxidation reaction zone, thereby producing an oxidation reaction mixture comprising the N-(phosphonomethyl)glycine product, the partial pressure of oxygen being not greater than about 50 psia at any location in the fixed bed at which the concentration of N-(phosphonomethyl)iminodiacetic acid substrate in the liquid phase is lower than about 0.1 ppm.

Claim 295 (original): The process as set forth in claim 294 wherein the partial pressure of oxygen is not greater than about 50 psia at any location in the fixed bed at which the concentration of N-(phosphonomethyl)iminodiacetic acid substrate in the liquid phase is lower than about 0.2 ppm.

Claim 296 (original): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

---

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into an oxidation reaction zone comprising a fixed bed containing an oxidation catalyst, the catalyst surface area to liquid holdup in the fixed bed being between about 100 and about 6000 m<sup>2</sup>/cm<sup>3</sup>;

introducing an oxidizing agent into the oxidation reaction zone; and

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate to the N-(phosphonomethyl)glycine product in the oxidation reaction zone, thereby producing an oxidation reaction mixture comprising the N-(phosphonomethyl)glycine product.

Claim 297 (original): The process as set forth in claim 296 wherein the ratio of catalyst surface area to liquid holdup in the fixed bed is between about 200 and about 2000 m<sup>2</sup>/cm<sup>3</sup>.

Claim 298 (original): The process as set forth in claim 297 wherein the ratio of catalyst surface area to liquid holdup in the fixed bed is between about 400 and about 1500 m<sup>2</sup>/cm<sup>3</sup>.

Claim 299 (original): The process as set forth in claim 297 wherein the catalyst comprises platinum on carbon and the platinum loading on the catalyst is less than 70% of the loading required to provide equivalent productivity in lbs. N-(phosphonomethyl)glycine product per hour per pound of catalyst at the same temperature in continuous stirred tank reactor utilizing a platinum on carbon a slurry catalyst.

Claim 300 (original): The process as set forth in claim 297 wherein the catalyst comprises a platinum on carbon catalyst containing less than 3 wt% platinum.

Claim 301 (original): The process as set forth in claim 296 wherein the integrated average partial pressure of oxygen along the liquid flow path in the fixed bed is at least about 50 psia.

---

~~Claim 302 (original): The process as set forth in claim 296~~  
wherein the integrated average temperature of the liquid phase in the fixed bed is between about 80°C and about 130°C.

Claim 303 (original): The process as set forth in claim 296 wherein the partial pressure of oxygen is not greater than about 50 psia at any location in the fixed bed at which the concentration of N-(phosphonomethyl)iminodiacetic acid substrate in the liquid phase is lower than about 0.1 ppm.

Claim 304 (original): The process as set forth in claim 297 wherein the partial pressure of oxygen is not greater than about



50 psia at any location in the fixed bed at which the concentration of N-(phosphonomethyl)iminodiacetic acid substrate in the liquid phase is lower than about 0.2 ppm.

Claim 305 (original): A process as set forth in claim 296 wherein the oxygen utilization in the oxidation reaction zone is between about 50% and about 95%.

Claim 306 (original): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into an oxidation reaction zone comprising a fixed bed containing an oxidation catalyst;

introducing an O<sub>2</sub>-containing gas into the oxidation reaction zone; and

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate to the N-(phosphonomethyl)glycine product in the oxidation reaction zone, thereby producing an oxidation reaction mixture comprising the N-(phosphonomethyl)glycine product, the integrated average partial pressure of oxygen along the liquid flow path in the fixed bed being at least about 50 psia and the integrated average temperature of the liquid phase in the fixed bed being between about 80°C and about 130°C.

---

Claim 307 (original): The process as set forth in claim 306 wherein the integrated average partial pressure of oxygen along the liquid flow path in the fixed bed is at least about 100 psia and the integrated average temperature of the liquid phase in the fixed bed is between about 105°C and about 120°C.

Claim 308 (original): The process as set forth in claim 306 wherein the oxygen partial pressure at the liquid exit of the fixed bed is not greater than about 100 psia.

Claim 309 (original): The process as set forth in claim 306 wherein the oxygen partial pressure is not greater than about 50 psia at any location in the bed wherein the concentration of N-(phosphonomethyl)iminodiacetic acid substrate in the liquid phase is lower than about 0.1 ppm.

Claim 310 (original): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into an oxidation reaction zone comprising a fixed bed containing oxidation catalyst bodies and other means for promoting gas/liquid mass transfer;

introducing an O<sub>2</sub>-containing gas into the oxidation reaction zone; and

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate to the N-(phosphonomethyl)glycine product in the oxidation reaction zone, thereby producing an oxidation reaction mixture comprising the N-(phosphonomethyl)glycine product.

Claim 311 (original): The process as set forth in claim 310 wherein said other means for promoting gas/liquid mass transfer comprises inert packing.

---

Claim 312 (original): The process as set forth in claim 311 wherein said packing functions as a diluent for the catalyst, thereby modulating the activity of the catalyst bed.

Claim 313 (original): The process as set forth in claim 312 wherein the activity of the catalyst bed varies in the direction of fluid flow as a function of variation of the surface area of the catalyst bodies relative to the surface area of the inert packing in said direction.

Claim 314 (original): The process as set forth in claim 311 wherein said inert packing is selected from the group consisting of rings, saddles and structured packing.

Claim 315 (original): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, the process comprising:

introducing a liquid phase feed stream comprising an aqueous feed mixture comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a primary oxidation reaction zone, the primary oxidation reaction zone comprising a fixed bed containing an oxidation catalyst;

introducing an oxidizing agent into the primary oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate to the N-(phosphonomethyl)glycine product in the primary oxidation reaction zone, thereby producing a liquid phase exit stream comprising a primary reaction mixture comprising the N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate; and

withdrawing said liquid phase exit stream from the primary oxidation reaction zone; the rate of introduction of said liquid phase feed stream and withdrawal of said liquid phase exit stream being such that the liquid phase hourly space velocity in said

---

fixed bed based on total bed volume is between about  $0.5 \text{ hr}^{-1}$  and about  $20 \text{ hr}^{-1}$ .

Claim 316 (original): The process as set forth in claim 315 wherein the liquid phase hourly space velocity in said fixed bed is between about  $3 \text{ hr}^{-1}$  and about  $20 \text{ hr}^{-1}$ .

Claim 317 (original): The process as set forth in claim 315 wherein the conversion of N-(phosphonomethyl)iminodiacetic acid substrate to N-(phosphonomethyl)glycine product within said fixed bed is at least about 50%.

Claim 318 (original): The process as set forth in claim 315 wherein said liquid hourly space velocity is between about  $0.5 \text{ hr}^{-1}$  and about  $5 \text{ hr}^{-1}$  and the conversion of N-(phosphonomethyl)iminodiacetic acid substrate to N-(phosphonomethyl)glycine product within said fixed bed is at least about 95%.

Claim 319 (original): The process as set forth in claim 315 wherein the residual N-(phosphonomethyl)iminodiacetic acid substrate in said primary oxidation reaction mixture is not greater than about 0.2 ppm.

Claim 320 (original): A process as set forth in claim 319 wherein said aqueous feed mixture contains at least about 15% by weight of a water-soluble salt of N-(phosphonomethyl)iminodiacetic acid on an acid equivalent basis, and wherein a final reaction mixture is produced which contains at least about 12% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis, said final oxidation reaction mixture comprising said primary oxidation reaction mixture, a primary product comprising a fraction of said primary oxidation reaction mixture, or a further reaction mixture obtained by introducing said primary reaction mixture or said primary product fraction into a secondary reaction system comprising one or more additional reaction zones for further oxidation of N-(phosphonomethyl)iminodiacetic acid substrate to N-(phosphonomethyl)glycine product and/or oxidation of formaldehyde or formic acid.

---

Claim 321 (original): The process as set forth in claim 320 wherein said aqueous feed mixture contains at least about 25% by weight of a water-soluble salt of N-(phosphonomethyl)iminodiacetic acid on an acid equivalent basis and said final oxidation reaction mixture contains at least about 20% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

Claim 322 (original): The process as set forth in claim 321 wherein said aqueous feed mixture contains at least about 35% by weight of a water-soluble salt of N-(phosphonomethyl)iminodiacetic acid on an acid equivalent basis and said final oxidation reaction mixture contains at least about 28% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

Claim 323 (original): The process as set forth in claim 320 wherein a final oxidation reaction is concentrated by removal of water therefrom.

Claim 324 (original): The process as set forth in claim 323 wherein said final reaction mixture is introduced into a flash evaporation zone wherein the pressure is lower than the vapor pressure of said final oxidation mixture at the temperature at which it exits said primary reactor or said secondary reaction system.

Claim 325 (original): The process as set forth in claim 323 wherein removal of water from said final oxidation reaction product produces a concentrated solution containing at least about 40% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

---

Claim 326 (canceled)

Claim 327 (original): The process as set forth in claim 315 wherein the temperature of said liquid phase exit stream from said primary reaction zone is maintained below a reference autogenous adiabatic reaction temperature that would result from absorption by said primary reaction mixture of the heat of reaction generated in said primary reaction zone in the absence of any measure to maintain a lower exit temperature.

Claim 328 (original): The process as set forth in claim 327 wherein maintaining the temperature of said liquid phase exit stream below said reference temperature comprises cooling of said fixed bed by indirect transfer of heat to a cooling fluid comprising a heat transfer or process fluid flowing through a conduit within or in contact with said bed.

Claim 329 (original): The process as set forth in claim 328 wherein said fixed bed is disposed within the shell or tube side of a shell and tube heat exchanger, said cooling fluid being passed through the other side of the exchanger.

Claim 330 (original): The process as set forth in claim 329 wherein said fixed bed comprises multiple component beds separately disposed in the tubes of a shell and tube heat exchanger, said aqueous feed mixture and oxidant being distributed among said component beds for conversion therein of said N-(phosphonomethyl)iminodiacetic acid substrate to said N-(phosphonomethyl)glycine product, said cooling fluid flowing through the shell side of said heat exchanger.

Claim 331 (currently amended): The process as set forth in claim 329 wherein said fixed bed is contained within the shell of a shell and tube heat exchanger [[,]].

---

Claim 332 (original): The process as set forth in claim 327 wherein said fixed bed comprises a noble metal on carbon catalyst, and the liquid phase reacting mixture passes in substantially plug flow through said fixed bed within said heat exchanger, thereby promoting oxidation of by-product formaldehyde and/or formic acid therein.

Claim 333 (original): The process as set forth in claim 327 wherein maintaining the temperature of said liquid phase exiting said bed below said reference temperature comprises introducing into said bed a recirculation fraction comprising N-

(phosphonomethyl)glycine produced in the reaction wherein said recirculation fraction has been cooled externally of said fixed bed, said liquid phase feed stream comprising said aqueous feed mixture and said recirculation fraction.

Claim 334 (original): The process as set forth in claim 333 comprising:

dividing the liquid phase exit stream into a primary product fraction and a primary reactor circulation fraction;

passing the liquid phase exit stream or the primary reactor recirculation fraction through a heat exchanger for removal of heat of oxidation of the N-(phosphonomethyl)iminodiacetic acid substrate; and

returning the primary reactor recirculation fraction to the primary oxidation reaction zone.

Claim 335 (original): The process as set forth in claim 334 wherein said primary reaction mixture is passed through said heat exchanger before said primary reaction mixture is divided.

Claim 336 (original): The process as set forth in claim 315 wherein said catalyst comprises a platinum on carbon catalyst comprising not greater than 3% platinum on a total catalyst basis.

---

Claim 337 (previously presented): A continuous process for the catalytic oxidation of an N-(phosphonomethyl)iminodiacetic acid substrate to produce an N-(phosphonomethyl)glycine product, comprising:

introducing a first component feed stream comprising an N-(phosphonomethyl)iminodiacetic acid substrate into the first of a series of continuous reaction zones, each of said series of reaction zones comprising an oxidation catalyst;

introducing an oxidant into said first of said series of reaction zones;

catalytically oxidizing said substrate in said first reaction zone to produce an intermediate reaction mixture containing N-(phosphonomethyl)glycine product;

transferring the intermediate reaction mixture exiting said first reaction zone to the second of said series of reaction zones;

catalytically oxidizing said substrate in each of said series of reaction zones;

withdrawing an intermediate reaction mixture from each of said reaction zones;

introducing into each succeeding reaction zone the intermediate reaction mixture produced in the preceding reaction zone;

introducing an additional component feed stream into each of one or more of said reaction zones succeeding said first reaction zone in said series, each said additional feed stream comprising an N-(phosphonomethyl)iminodiacetic acid substrate;

introducing an oxidant into one or more said reaction zones succeeding said first reaction zone in said series; and

withdrawing a final reaction product from the last in said series of reaction zones.

Claim 338 (previously presented): A process as set forth in claim 337 wherein an additional component feed stream comprising an N-(phosphonomethyl)iminodiacetic acid substrate is introduced into each of said series of reaction zones.

---

Claim 339 (previously presented): A process as set forth in claim 337 wherein an oxidant is introduced into each of said series of reaction zones.

Claim 340 (previously presented): A process as set forth in claim 339 wherein there are at least three continuous reaction zones in said series.



Claim 341 (previously presented): A process as set forth in claim 337 wherein one or more of said additional component feed streams contains solid N-(phosphonomethyl)iminodiacetic acid substrate.

Claim 342 (previously presented): A process as set forth in claim 337 wherein said N-(phosphonomethyl)iminodiacetic acid substrate comprises a water-soluble salt of N-(phosphonomethyl)iminodiacetic acid and the average concentration of said salt among said component feed solutions is such that said final reaction product contains at least about 10% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

Claim 343 (previously presented): A process as set forth in claim 342 wherein said average concentration of said salt in said component feed solutions is such that the final reaction product contains at least about 20% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

Claim 344 (previously presented): A process as set forth in claim 343 wherein said average concentration of said salt in said component feed solutions is such that the final reaction product contains at least about 28% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

---

Claim 345 (previously presented): A process as set forth in claim 337 wherein the final reaction product is concentrated by removal of water therefrom.

Claim 346 (previously presented): A process as set forth in claim 345 wherein said final reaction product is introduced into a flash evaporation zone wherein the pressure is lower than the vapor pressure of said final reaction product at the temperature at which it exits the last in said series of reaction zones.

Claim 347 (previously presented): A process as set forth in claim 345 wherein removal of water from said final oxidation reaction product produces a concentrated solution containing at least about 40% by weight of a water-soluble salt of N-(phosphonomethyl)glycine on an acid equivalent basis.

Claim 348 (previously presented): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a liquid reaction medium within an oxidation reaction zone provided by an ejector nozzle loop reactor, the oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction suspended in the liquid reaction medium, the catalyst comprising a noble metal deposited on a particulate carbon support, the liquid reaction medium comprising the N-(phosphonomethyl)glycine product;

introducing an oxidizing agent into the oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the oxidation reaction zone to form the N-(phosphonomethyl)glycine product; and

---

continuously withdrawing a reaction mixture effluent comprising the N-(phosphonomethyl)glycine product from the oxidation reaction zone.

Claim 349 (previously presented): The process as set forth in claim 348 wherein the oxidizing agent is an O<sub>2</sub>-containing gas and is introduced simultaneously with the aqueous feed stream into the oxidation reaction zone through an ejector nozzle of the ejector nozzle loop reactor.

Claim 350 (previously presented): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a liquid reaction medium within an oxidation reaction zone provided by a continuous stirred tank reactor, the oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction suspended in the liquid reaction medium, the catalyst comprising a noble metal deposited on a particulate carbon support, the liquid reaction medium comprising the N-(phosphonomethyl)glycine product;

introducing an oxidizing agent into the oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the oxidation reaction zone to form the N-(phosphonomethyl)glycine product; and

continuously withdrawing a reaction mixture effluent comprising the N-(phosphonomethyl)glycine product from the oxidation reaction zone, the reaction mixture effluent withdrawn from the oxidation reaction zone being substantially free of the particulate catalyst, the stirred tank reactor comprising an ~~internal catalyst filter for preventing the particulate catalyst~~  
from being withdrawn from the oxidation reaction zone with the reaction mixture effluent.

Claim 351 (previously presented): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a liquid reaction medium within an oxidation reaction zone provided by a continuous stirred tank reactor, the oxidation reaction zone

being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction suspended in the liquid reaction medium, the catalyst comprising a noble metal deposited on a particulate carbon support, the liquid reaction medium comprising the N-(phosphonomethyl)glycine product;

introducing an oxidizing agent into the oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the oxidation reaction zone to form the N-(phosphonomethyl)glycine product;

continuously withdrawing a reaction mixture effluent comprising the N-(phosphonomethyl)glycine product and the particulate catalyst from the oxidation reaction zone;

separating the particulate catalyst from the reaction mixture effluent to form a catalyst recycle stream comprising the separated particulate catalyst; and

introducing at least a portion of the particulate catalyst contained in the catalyst recycle stream into the oxidation reaction zone.

Claim 352 (previously presented): The process as set forth in claim 351 wherein catalyst is purged from the catalyst recycle stream.

---

Claim 353 (previously presented): The process as set forth in claim 352 wherein fresh catalyst is added to the catalyst recycle stream.

Claim 354 (previously presented): The process as set forth in claim 351 wherein the particulate catalyst is separated from the reaction mixture effluent in a catalyst filter to form the catalyst recycle stream and a filtrate substantially free of the particulate catalyst and comprising the N-(phosphonomethyl)glycine product.

Claim 355 (previously presented): The process as set forth in claim 354 wherein the catalyst filter is adapted for continuous separation of particulate catalyst from the reaction mixture effluent.

Claim 356 (previously presented): The process as set forth in claim 355 wherein the catalyst filter is a continuous cross-flow filter.

Claim 357 (previously presented): The process as set forth in claim 355 wherein the catalyst filter is a continuous back-pulse filter.

Claim 358 (previously presented): The process as set forth in claim 357 wherein the back-pulse filter comprises a filter element and a portion of the filtrate is used to back-pulse the filter element and remove separated catalyst from the filter element.

Claim 359 (previously presented): The process as set forth in claim 357 wherein the reaction mixture effluent further comprises dissolved  $\text{CO}_2$ , the reaction mixture effluent being passed through a flash tank before being introduced into the catalyst filter to lower the pressure on the reaction mixture effluent and remove dissolved  $\text{CO}_2$  from the reaction mixture effluent.

---

Claim 360 (previously presented): The process as set forth in claim 357 wherein at least a portion of the particulate catalyst contained in the catalyst recycle stream passes through a catalyst holding tank before being introduced into the oxidation reaction zone.

Claim 361 (previously presented): The process as set forth in claim 360 wherein the catalyst holding tank is substantially free of  $\text{O}_2$ .

Claim 362 (previously presented): The process as set forth in claim 361 further comprising introducing a non-oxidizing gas into the catalyst holding tank.

Claim 363 (previously presented): The process as set forth in claim 361 wherein the residence time of the recycled catalyst in the catalyst holding tank is at least about 2 minutes.

Claim 364 (previously presented): The process as set forth in claim 354 wherein the filtrate comprises unreacted - (phosphonomethyl)iminodiacetic acid substrate, the process further comprising:

continuously introducing the filtrate into a second oxidation reaction zone;

introducing an oxidizing agent into the second oxidation reaction zone; and

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the second oxidation reaction zone to form additional N-(phosphonomethyl)glycine product.

Claim 365 (previously presented): The process as set forth in claim 364 wherein the second oxidation reaction zone is substantially back-mixed in the liquid phase.

---

~~Claim 366 (previously presented): The process as set forth in~~  
claim 365 wherein the second oxidation reaction zone is provided by a second stirred tank reactor.

Claim 367 (previously presented): The process as set forth in claim 365 wherein the second oxidation reaction zone is provided by an ejector nozzle loop reactor.

Claim 368 (previously presented): The process as set forth in claim 364 wherein the second oxidation reaction zone is provided by a fixed bed reactor.

Claim 369 (previously presented): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate in a reactor system, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a first oxidation reaction zone provided by an ejector nozzle loop reactor, the first oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate;

introducing an oxidizing agent into the first oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the first oxidation reaction zone to form the N-(phosphonomethyl)glycine product;

continuously withdrawing an intermediate reaction mixture effluent comprising the N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate from the first oxidation reaction zone;

continuously introducing an intermediate aqueous feed stream into a second oxidation reaction zone containing a catalyst for the oxidation reaction, the intermediate aqueous feed stream comprising N-(phosphonomethyl)glycine product and unreacted

---

N-(phosphonomethyl)iminodiacetic acid substrate obtained in the intermediate reaction mixture effluent;

introducing an oxidizing agent into the second oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the second oxidation reaction zone to form additional N-(phosphonomethyl)glycine product; and

continuously withdrawing a reaction mixture effluent comprising the N-(phosphonomethyl)glycine product from the second oxidation reaction zone.

Claim 370 (previously presented): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate in a reactor system, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a first oxidation reaction zone provided by a continuous stirred tank reactor, the first oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate;

introducing an O<sub>2</sub>-containing gas into the first oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the first oxidation reaction zone to form the N-(phosphonomethyl)glycine product;

continuously withdrawing an intermediate reaction mixture effluent comprising the N-(phosphonomethyl)glycine product and unreacted -(phosphonomethyl)iminodiacetic acid substrate from the first oxidation reaction zone;

continuously introducing an intermediate aqueous feed stream into a second oxidation reaction zone provided by an ejector nozzle loop reactor, the second oxidation reaction zone being substantially back-mixed in the gas and liquid phases and

---

containing a heterogenous particulate catalyst for the oxidation reaction suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate, the intermediate aqueous feed stream comprising N-(phosphonomethyl)glycine product and unreacted -(phosphonomethyl)iminodiacetic acid substrate obtained in the intermediate reaction mixture effluent;

introducing an O<sub>2</sub>-containing gas into the second oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the second oxidation reaction zone to form additional N-(phosphonomethyl)glycine product; and



continuously withdrawing a reaction mixture effluent comprising the N-(phosphonomethyl)glycine product from the second oxidation reaction zone.

Claim 371 (currently amended): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate in a reactor system, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a first oxidation reaction zone provided by a first continuous stirred tank reactor, the first oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction comprising a noble metal deposited on a particulate carbon support and suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate, the carbon support exhibiting a particle size distribution such that about 95% of the catalyst particles are from about 3 to about 100  $\mu\text{m}$  in their largest dimensions, the concentration of the particulate catalyst within the first oxidation reaction zone being from about 0.1 to about 10 wt.% based on the total weight of catalyst and the liquid reaction medium in the oxidation reaction zone;

introducing an oxidizing agent into the first oxidation reaction zone;

---

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the first oxidation reaction zone to form the N-(phosphonomethyl)glycine product;

continuously withdrawing an intermediate reaction mixture effluent comprising the N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate from the first oxidation reaction zone;

continuously introducing an intermediate aqueous feed stream into a second oxidation reaction zone provided by a second continuous stirred tank reactor, the second oxidation reaction zone being substantially back-mixed in the liquid phase and

containing a heterogenous particulate catalyst for the oxidation reaction comprising a noble metal deposited on a particulate carbon support and suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate, the carbon support exhibiting a particle size distribution such that about 95% of the catalyst particles are from about 3 to about 100  $\mu\text{m}$  in their largest dimension, the concentration of the particulate catalyst within the second oxidation reaction zone being from about 0.1 to about 10 wt.% based on the total weight of catalyst and the liquid reaction medium in the oxidation reaction zone, the intermediate aqueous feed stream comprising N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate obtained in the intermediate reaction mixture effluent;

introducing an oxidizing agent into the second oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the second oxidation reaction zone to form additional N-(phosphonomethyl)glycine product;

continuously withdrawing a reaction mixture effluent comprising the N-(phosphonomethyl)glycine product and the particulate catalyst from the second oxidation reaction zone; and

separating the particulate catalyst from the reaction mixture effluent withdrawn from the second oxidation reaction zone to form a catalyst recycle stream comprising the separated catalyst.

---

Claim 372 (previously presented): The process as set forth in claim 371 further comprising introducing at least a portion of the particulate catalyst contained in the catalyst recycle stream into at least one of the first and second oxidation reaction zones.

Claim 373 (previously presented): The process as set forth in claim 372 wherein the particulate catalyst is separated from the reaction mixture effluent in a catalyst filter to form the

catalyst recycle stream and a filtrate substantially free of the particulate catalyst and comprising the N-(phosphonomethyl)glycine product.

Claim 374 (previously presented): The process as set forth in claim 373 wherein the catalyst filter is adapted for continuous separation of particulate catalyst from the reaction mixture effluent.

Claim 375 (previously presented): The process as set forth in claim 374 wherein the catalyst filter is a continuous back-pulse filter.

Claim 376 (previously presented): The process as set forth in claim 375 wherein the back-pulse filter comprises a filter element and a portion of the filtrate is used to back-pulse the filter element and remove separated catalyst from the filter element.

Claim 377 (previously presented): The process as set forth in claim 375 wherein at least a portion of the particulate catalyst contained in the catalyst recycle stream passes through a catalyst holding tank before being introduced into at least one of the first and second oxidation reaction zones.

---

Claim 378 (previously presented): The process as set forth in claim 377 wherein the catalyst holding tank is substantially free of O<sub>2</sub>.

Claim 379 (previously presented): The process as set forth in claim 378 further comprising introducing a non-oxidizing gas into the catalyst holding tank.

Claim 380 (previously presented): The process as set forth in claim 378 wherein the residence time of the recycled catalyst in the catalyst holding tank is at least about 2 minutes.

Claim 381 (previously presented): The process as set forth in claim 372 wherein at least a portion of the particulate catalyst contained in the catalyst recycle stream is introduced into the first oxidation reaction zone concurrently with the N-(phosphonomethyl)iminodiacetic acid substrate.

Claim 382 (previously presented): The process as set forth in claim 372 wherein at least a portion of the particulate catalyst contained in the catalyst recycle stream is introduced into the second oxidation reaction zone concurrently with the unreacted N-(phosphonomethyl)iminodiacetic acid substrate obtained in the intermediate aqueous reaction mixture effluent.

Claim 383 (previously presented): The process as set forth in claim 372 wherein a portion of the particulate catalyst contained in the catalyst recycle stream is introduced into the first oxidation reaction zone concurrently with the N-(phosphonomethyl)iminodiacetic acid substrate and another portion of the particulate catalyst contained in the catalyst recycle stream is introduced into the second oxidation reaction zone concurrently with the unreacted N-(phosphonomethyl)iminodiacetic acid substrate obtained in the intermediate aqueous reaction mixture effluent.

---

~~Claim 384 (previously presented): The process as set forth in~~  
claim 372 wherein catalyst is purged from the catalyst recycle stream.

Claim 385 (previously presented): The process as set forth in claim 384 wherein fresh catalyst is added to the catalyst recycle stream.

Claim 386 (currently amended): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate in a reactor system, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a first oxidation reaction zone provided by a first continuous stirred tank reactor, the first oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction comprising a noble metal deposited on a particulate carbon support and suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate, the carbon support exhibiting a particle size distribution such that about 95% of the catalyst particles are from about 3 to about 100  $\mu\text{m}$  in their largest dimensions, the concentration of the particulate catalyst within the first oxidation reaction zone being from about 0.1 to about 10 wt.% based on the total weight of catalyst and the liquid reaction medium in the oxidation reaction zone;

introducing an oxidizing agent into the first oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the first oxidation reaction zone to form the N-(phosphonomethyl)glycine product;

continuously withdrawing an intermediate reaction mixture effluent comprising the N-(phosphonomethyl)glycine product, unreacted N-(phosphonomethyl)iminodiacetic acid substrate and the particulate catalyst from the first oxidation reaction zone;

~~separating the particulate catalyst from the intermediate~~  
reaction mixture effluent withdrawn from the first oxidation reaction zone to form a catalyst recycle stream comprising the separated catalyst;

introducing at least a portion of the particulate catalyst contained in the catalyst recycle stream into the first oxidation reaction zone concurrently with the N-(phosphonomethyl)iminodiacetic acid substrate;

continuously introducing an intermediate aqueous feed stream into a second oxidation reaction zone provided by a second continuous stirred tank reactor, the second oxidation reaction zone being substantially back-mixed in the liquid phase and

containing a heterogenous particulate catalyst for the oxidation reaction comprising a noble metal deposited on a particulate carbon support and suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate, the carbon support exhibiting a particle size distribution such that about 95% of the catalyst particles are from about 3 to about 100  $\mu\text{m}$  in their largest dimension, the concentration of the particulate catalyst within the second oxidation reaction zone being from about 0.1 to about 10 wt.% based on the total weight of catalyst and the liquid reaction medium in the oxidation reaction zone, the intermediate aqueous feed stream comprising N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate obtained in the intermediate reaction mixture effluent;

introducing an oxidizing agent into the second oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the second oxidation reaction zone to form additional N-(phosphonomethyl)glycine product; and

continuously withdrawing a reaction mixture effluent comprising the N-(phosphonomethyl)glycine product from the second oxidation reaction zone.

Claim 387 (previously presented): The process as set forth in claim 386 wherein the particulate catalyst is separated from the intermediate reaction mixture effluent in a catalyst filter to form the catalyst recycle stream and a filtrate substantially free of the particulate catalyst and comprising the N-(phosphonomethyl)glycine product and the intermediate aqueous feed stream introduced into the second oxidation reaction zone comprises the filtrate.

Claim 388 (previously presented): The process as set forth in claim 387 wherein the reaction mixture effluent withdrawn from the second oxidation reaction zone further comprises the particulate catalyst, the process further comprising separating

the particulate catalyst from the reaction mixture effluent withdrawn from the second oxidation reaction zone to form a second catalyst recycle stream comprising the separated catalyst.

Claim 389 (previously presented): The process as set forth in claim 388 wherein the particulate catalyst is separated from the reaction mixture effluent in a second catalyst filter to form the second catalyst recycle stream and a second filtrate substantially free of the particulate catalyst and comprising the N-(phosphonomethyl)glycine product.

Claim 390 (previously presented): The process as set forth in claim 389 further comprising introducing at least a portion of the particulate catalyst contained in the second catalyst recycle stream into at least one of the first and second oxidation reaction zones.

Claim 391 (previously presented): The process as set forth in claim 390 wherein at least a portion of the particulate catalyst contained in the second catalyst recycle stream is introduced into the second oxidation reaction zone concurrently with the unreacted N-(phosphonomethyl)iminodiacetic acid substrate obtained in the intermediate reaction mixture effluent.

---

Claim 392 (previously presented): ~~The process as set forth in~~ claim 391 wherein the average age of the catalyst in the first oxidation reaction zone is different from the average age of the catalyst in the second oxidation reaction zone.

Claim 393 (previously presented): The process as set forth in claim 392 wherein the average age of the catalyst in the first oxidation reaction zone is greater than the average age of the catalyst in the second oxidation reaction zone.

Claim 394 (previously presented): The process as set forth in claim 392 wherein the average age of the catalyst in the first

oxidation reaction zone is less than the average age of the catalyst in the second oxidation reaction zone.

Claim 395 (previously presented): The process as set forth in claim 389 wherein the catalyst filters are adapted for continuous separation of particulate catalyst from the intermediate reaction mixture effluent and the reaction mixture effluent.

Claim 396 (currently amended): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate in a reactor system, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a first oxidation reaction zone provided by a first continuous stirred tank reactor, the first oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction comprising a noble metal deposited on a particulate carbon support and suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate, the carbon support exhibiting a particle size distribution such that about 95% of the catalyst particles are from about 3 to about 100  $\mu\text{m}$  in their largest dimensions, the concentration of the particulate catalyst within the first oxidation reaction zone being from

---

about 0.1 to about 10 wt.% based on the total weight of catalyst and the liquid reaction medium in the oxidation reaction zone;

introducing an oxidizing agent into the first oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the first oxidation reaction zone to form the N-(phosphonomethyl)glycine product;

cooling the liquid reaction medium in the first oxidation reaction zone;

continuously withdrawing an intermediate reaction mixture effluent comprising the N-(phosphonomethyl)glycine product and



unreacted N-(phosphonomethyl)iminodiacetic acid substrate from the first oxidation reaction zone;

continuously introducing an intermediate aqueous feed stream into a second oxidation reaction zone operated adiabatically and provided by a second continuous stirred tank reactor, the second oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction comprising a noble metal deposited on a particulate carbon support and suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate, the carbon support exhibiting a particle size distribution such that about 95% of the catalyst particles are from about 3 to about 100  $\mu\text{m}$  in their largest dimension, the concentration of the particulate catalyst within the second oxidation reaction zone being from about 0.1 to about 10 wt.% based on the total weight of catalyst and the liquid reaction medium in the oxidation reaction zone, the intermediate aqueous feed stream comprising N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate obtained in the intermediate reaction mixture effluent;

introducing an oxidizing agent into the second oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the second oxidation reaction zone to form additional N-(phosphonomethyl)glycine product; and

---

continuously withdrawing a reaction mixture effluent comprising the N-(phosphonomethyl)glycine product from the second oxidation reaction zone.

Claim 397 (currently amended): A process for preparing an N-(phosphonomethyl)glycine product by oxidizing an N-(phosphonomethyl)iminodiacetic acid substrate in a reactor system, the process comprising:

introducing an aqueous feed stream comprising the N-(phosphonomethyl)iminodiacetic acid substrate into a first oxidation reaction zone provided by a first continuous stirred

tank reactor, the first oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction comprising a noble metal deposited on a particulate carbon support and suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate, the carbon support exhibiting a particle size distribution such that about 95% of the catalyst particles are from about 3 to about 100  $\mu\text{m}$  in their largest dimensions, the concentration of the particulate catalyst within the first oxidation reaction zone being from about 0.1 to about 10 wt.% based on the total weight of catalyst and the liquid reaction medium in the oxidation reaction zone;

introducing an oxidizing agent into the first oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the first oxidation reaction zone to form the N-(phosphonomethyl)glycine product;

cooling the liquid reaction medium in the first oxidation reaction zone;

continuously withdrawing an intermediate reaction mixture effluent comprising the N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate from the first oxidation reaction zone;

continuously introducing an intermediate aqueous feed stream into a second oxidation reaction zone provided by a second

---

continuous stirred tank reactor, the second oxidation reaction zone being substantially back-mixed in the liquid phase and containing a heterogenous particulate catalyst for the oxidation reaction comprising a noble metal deposited on a particulate carbon support and suspended in a liquid reaction medium comprising the N-(phosphonomethyl)iminodiacetic acid substrate, the carbon support exhibiting a particle size distribution such that about 95% of the catalyst particles are from about 3 to about 100  $\mu\text{m}$  in their largest dimension, the concentration of the particulate catalyst within the second oxidation reaction zone being from about 0.1 to about 10 wt.% based on the total weight

of catalyst and the liquid reaction medium in the oxidation reaction zone, the intermediate aqueous feed stream comprising N-(phosphonomethyl)glycine product and unreacted N-(phosphonomethyl)iminodiacetic acid substrate obtained in the intermediate reaction mixture effluent;

introducing an oxidizing agent into the second oxidation reaction zone;

continuously oxidizing the N-(phosphonomethyl)iminodiacetic acid substrate in the second oxidation reaction zone to form additional N-(phosphonomethyl)glycine product;

cooling the liquid reaction medium in the second oxidation reaction zone; and

continuously withdrawing a reaction mixture effluent comprising the N-(phosphonomethyl)glycine product from the second oxidation reaction zone.

Claim 398 (previously presented): The process as set forth in claim 397 wherein the liquid reaction medium in the second oxidation reaction zone is cooled in an external heat transfer recirculation loop comprising a heat exchanger associated with the second stirred tank reactor.

Claim 399 (previously presented): The process as set forth in claim 397 wherein the temperature of the liquid reaction medium in the first oxidation reaction zone is maintained at from about 95°C to about 105°C and the temperature of the liquid reaction medium in the second oxidation reaction zone is maintained at from about 100°C to about 105°C.